FLORIDA BAY
PERFORMANCE MEASURE: Salinity in coastal basins estimated from upstream water stages

DRAFT DOCUMENTATION

GAGE P33

An ecosystem restoration performance measure for the coastal basins between the mangrove estuaries and Florida Bay is to decrease the frequency that salinity exceeds upper levels that have been identified for each basin through the conceptual model process. Another criterion is to increase the frequency that salinity drops below lower levels that have been identified for each basin.

Table 1. Lower and upper salinity levels identified for coastal basins. It is desirable to decrease the frequency that salinity exceeds upper levels, and to increase the frequency that salinity drops below lower levels.

Basin	Lower Level	Upper Level
Joe bay	5 ppt	15 ppt
Little Madeira Bay	15 ppt	25 ppt
Terrapin Bay	25 ppt	35 ppt
Garfield Bight	25 ppt	35 ppt
North River Mouth	5 ppt	15 ppt

Salinity in the coastal basins during the 1965-95 period of record is estimated based on relationships of salinity to water level upstream in the Everglades between 1991 and 1996. The salinity data base is the Everglades National Park Marine Monitoring Network of monthly measurements between March 1991and November 1996 for all basins except Garfield (beginning April 91) and North River Mouth (beginning September 92). The hydrology data base consists of mean monthly stages at Gage P33 in central Shark River Slough for the above periods of record. Plots of data indicated relationships between P33 stage and salinity at North River, Garfield, Terrapin, Little Madeira, and Joe Bay stations. Linear and logarithmic regressions and correlation coefficients were calculated for monthly stage and salinity, with and without a one-month lag between stage and salinity.

Table 2. Regressions of monthly salinity measurements in coastal basins to mean monthly water stages at Gage P33. Y = estimated monthly basin salinity, ppt. X = mean monthly water stage, feet msl.

One Month Lag		
Joe Bay	Y = 93.80906 – 12.74765 X	r = -0.681
Little Madeira Bay	Y = 104.66179 – 12.59143 X	r = -0.786
Terrapin Bay	Y = 104.06310 – 10.99946 X	r = -0.757
Garfield Bight*	Y = 98.55244 – 10.08526 X	r = -0.603
North River Mouth	Y = 86.59670 – 11.44561 X	r = -0.753
No Lag		
Joe Bay	Y = 105.30364 – 14.47855 X	r = -0.767
Little Madeira Bay	Y = 105.03918 – 12.58630 X	r = -0.781
Terrapin Bay	Y = 104.51874 – 11.02513 X	r = -0.725
Garfield Bight*	Y = 103.21753 – 10.65292 X	r = -0.717
North River Mouth	Y = 82.46741 – 10.83615 X	r = -0.710
One Month Lag		
Joe Bay	Log Y = 5.66546 – 5.87390 (Log X)	r = -0.478
Little Madeira Bay	Log Y = 4.05290 – 3.36524 (Log X)	r = -0.816
Terrapin Bay	Log Y = 3.20740 – 2.10421 (Log X)	r = -0.766
Garfield Bight*	Log Y = 3.23547 – 2.13045 (Log X)	r = -0.710
North River Mouth	Log Y = 9.38896 – 10.38043 (Log X)	r = -0.828

No Lag		
Joe Bay	Log Y = 6.57057 – 6.97901 (Log X)	r = -0.568
Little Madeira Bay	Log Y = 4.06679 – 3.37191 (Log X)	r = -0.817
Terrapin Bay	Log Y = 3.27548 – 2.19067 (Log X)	r = -0.735
Garfield Bight*	Log Y = 3.13348 – 1.99352 (Log X)	r = -0.714
North River Mouth	Log Y = 9.55422 – 10.57491 (Log X)	r = -0.845

* One anomalous data point for June 1992 was deleted from the Garfield Bight salinity data base.

Regressions incorporating a one month lag between stage and salinity are used to estimate salinity. There was no consistent difference between correlation coefficients of lagged versus non-lagged relationships. P33 stages that were back-calculated from salinity levels in each basin were nearly identical for lagged and non-lagged relationships (Table 3). One month lags assured that a mean monthly stage was always antecedent to a salinity measurement during the next month, but this was not necessarily the case for a mean monthly stage and a salinity measurement during the same month.

Linear regressions are used to estimate salinity. Although logarithmic regressions provided good correlation to P33 stages for the 1991-96 data set, they over-estimated salinity in comparison to measured values at nearby stations during drought years of the period of record prior to 1991. Linear regressions also provided good correlation to P33 stages for the 1991-96 data set, and they provided salinity estimates that were within the range of salinity measurements at nearby stations prior to 1991.

Linear regressions with a one month lag between stage and salinity were used to estimate monthly salinity for the 1965-95 period of record. The regressions indicated that stages of 7.3 and 6.3 feet msl at P33 produce the lower and upper salinity levels for Joe Bay, Little Madeira Bay, Terrapin Bay, Garfield Bight, and North River Mouth.

Table 3. Predicted stages (feet, msl) at Gage P33 that produce lower and upper salinity levels in coastal basins.

	Predicted Stage at P33 For Salinity Values in Basins	
Joe Bay	5 ppt	15 ppt
One Month Lag	7.0 ft	6.2 ft
No Lag	6.9 ft	6.2 ft
Little Madeira Bay	15 ppt	25 ppt
One Month Lag	7.1 ft	6.3 ft
No Lag	7.2 ft	6.4 ft
Terrapin Bay	25 ppt	35 ppt
One Month Lag	7.1 ft	6.3 ft
No Lag	7.2 ft	6.3 ft
Garfield Bight	25 ppt	35 ppt
One Month Lag	7.3 ft	6.3 ft
No Lag	7.3 ft	6.4 ft
North River Mouth	5 ppt	15 ppt
One Month Lag	7.1 ft	6.2 ft
No Lag	7.2 ft	6.2 ft

Gage P33 is located in cell 17 20 of the SFWMM. Simulated P33 water stages (msl) for the period of record are actually for cell 17 20. Comparison was made between recorded mean monthly stages at P33

and mean monthly stages that are simulated by 95BASE for cell 17 20. For the 1991-96 data set that was used in the stage/salinity regressions, the mean difference was a 0.12 foot higher stage for 95BASE in comparison to recorded P33 stages. The close approximation of P33 stages by 95BASE resulted in salinity estimates for Little Madeira, Terrapin, Garfield and North River that were comparable to recorded values, for the 1991-96 salinity data used for the regressions, and for salinity data that were collected between 1965 and 1991.

Recommendations. In order to decrease the frequency that coastal basin salinity exceeds the upper levels identified for each basin, raise P33 stages above 6.3 feet msl during the months of the period of record when NSM45 exceeds that stage, but the C&SF Comprehensive Plan alternative does not. In order to increase the frequency that coastal basin salinity drops below the lower levels identified for each basin, raise P33 stages above 7.3 feet msl during the months of the period of record when NSM45 exceeds that stage, buy the C&SF Comprehensive Plan alternative does not.

GAGE TSB

A similar analysis was made to estimate coastal basin salinity based on gage TSB in Taylor Slough using the same data bases as described above. Plots of data indicated relationships between Gage TSB and salinity at Joe Bay, Little Madeira Bay, and Garfield Bight stations.

Table 4. Regressions of monthly salinity measurements in coastal basins to mean monthly water stages at Gage TSB. Y = estimated monthly basin salinity, ppt. X = mean monthly water stage, feet msl.

One Month Lag		
Joe Bay	Y = 50.97941 – 10.61313 X	r = -0.833
Little Madeira Bay	Y = 54.76072 – 8.31909 X	r = -0.779
Garfield Bight	Y = 59.87545 – 7.01454 X	r = -0.623
No Lag		
Joe Bay	Y = 50.08472 – 10.20433 X	r = -0.784
Little Madeira Bay	Y = 48.90825 – 6.66126 X	r = -0.599
Garfield Bight	Y = 55.03864 – 5.68096 X	r = -0.524
One Month Lag		
Joe Bay	Log Y = 2.12262 – 2.17012 (Log X)	r = -0.554
Little Madeira Bay	Log Y = 1.86116 – 0.93149 (Log X)	r = -0.733
Garfield Bight	Log Y = 1.82469 – 0.56048 (Log X)	r = -0.544
No Lag		
Joe Bay	Log Y = 2.15742 – 2.17615 (Log X)	r = -0.551
Little Madeira Bay	Log Y = 1.77136 – 0.57945 (Log X)	r = -0.570
Garfield Bight	Log Y = 1.78895 – 0.49633 (Log X)	r = -0.508

Linear regressions with a one month lag between stage and salinity were used to estimate salinity for the 1965-95 period of record. The regressions indicated that stages of 5.0 and 3.6 feet msl at TSB produce the lower and upper salinity levels for Joe Bay, Little Madeira Bay, and Garfield Bight.

Table 5. Predicted stages (feet, msl) at Gage TSB that produce lower and upper sailnity levels in coastal basins.

	Predicted Stage at TSB For Salinity Values in Basins	
Joe Bay	5 ppt	15 ppt
One Month Lag	4.3 ft	3.4 ft
No Lag	4.4 ft	3.4 ft

Little Madeira Bay	15 ppt	25 ppt
One Month Lag	4.8 ft	3.6 ft
No Lag	5.1 ft	3.6 ft

Garfield Bight	25 ppt	35 ppt
One Month Lag	5.0 ft	3.5 ft
No Lag	5.3 ft	3.5 ft

A comparison was made between recorded mean monthly stages at TSB and mean monthly stages that are simulated by 95BASE for cell 9 23, where the TSB gage is located. For the 1991-96 data set, the mean difference was a 0.79 foot lower stage for 95BASE in comparison to recorded TSB stages. The under-estimation of TSB stages by the SFWMM resulted in substantial over-estimation of Little Madeira Bay, Joe Bay, and Garfield Bight salinity in comparison to recorded values. Thus SFWMM stage simulations are not used to estimate salinity in those basins based on the TSB stage/salinity relationships.